

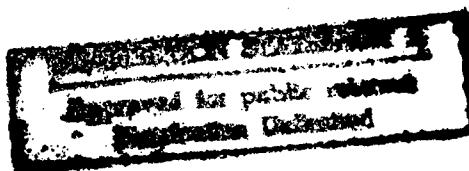
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20 September 1984

China Report

SCIENCE AND TECHNOLOGY



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20 September 1984

CHINA REPORT
SCIENCE AND TECHNOLOGY

CONTENTS

PEOPLE'S REPUBLIC OF CHINA

APPLIED SCIENCES

Second National Color Optics Symposium Held in Qingdao (Li Feng; GUANGXUE XUEBAO, No 3, 1984).....	1
Second National Symposium on New Laser Crystals Held in Quanzhou (Yi Min, Xian San; GUANGXUE XUEBAO, No 3, 1984).....	2
Nickel and Chromium Free Stainless for Marine Applications (Wei Zhenyu; GANGTIE, No 4, 1984).....	4
Machine-Building Industry Society Holds Meeting (JIXIE GONGYE ZIDONGHUA, No 2, 1984).....	9
Off-Wall Rock Linings for Underground Structures (DIXIA GONGCHENG, No 12, 1983).....	13
Vibration Problems in Satellites of Composite Structure (Zhang Jidong; DIZHEN GONGCHENG YU GONGCHENG ZHENDONG, No 4, 1983).....	20

ABSTRACTS

AERODYNAMICS

DAQI DONGLIXUE [ACTA AERODYNAMICA SINICA] No 1, 1984.....	29
---	----

CHEMISTRY

FENXI HUAXUE [ANALYTICAL CHEMISTRY] No 2, 20 Feb 84..... 31

YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] No 3,
Jun 84..... 32

FUEL CHEMISTRY

RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND
TECHNOLOGY] No 3, Sep 83 35

GEOLOGY

DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] No 1, 1984..... 40

HEMATOLOGY

ZHONGHUA XUEYEXUE ZAZHI [CHINESE JOURNAL OF HEMATOLOGY] No 3,
30 Jun 84) 41

MINERALOGY

KUANGWU XUEBAO [ACTA MINERALOGICA SINICA] No 1, 1984..... 42

ONCOLOGY

ZHONGHUA ZHONGLIU ZAZHI [CHINESE JOURNAL OF ONCOLOGY] No 3,
23 May 84..... 44

PHARMACOLOGY

YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] No 3, 29 Mar 84..... 47

RADIOLOGY

ZHONGHUA FANGSHE YIXUE YU FANGHU ZAZHI [CHINESE JOURNAL OF
RADIOLOGICAL MEDICINE AND PROTECTION] No 3, 25 Jun 84..... 49

APPLIED SCIENCES

SECOND NATIONAL COLOR OPTICS SYMPOSIUM HELD IN QINGDAO

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese No 3, 1984 p 205

[Article by Li Feng [7812 7264]]

[Text] The Second Color Optics Symposium was held on Dec 2-4, 1983, by arrangement with the Shandong Textile Institute under the auspices of the Committee of Color Optics Specialists of the Chinese Optical Society.

More than 80 representatives from nearly 60 worker units in 13 provinces throughout China participated in the symposium. The meeting was attended by Wang Daheng [3769 1129 3801], chairman of the Chinese Optical Society, who gave an important speech. The 52 technical papers presented at the conference dealt with textile and silk processing, printing, traffic signals, photography, lighting, psychological aspects of color, color matching by computer, and military camouflage. The discussions focused on the development of instruments, principles, and methods of color measurement, and on topics of color temperature measurement and coloration characteristics of optical sources. Both theoretical and practical aspects were considered.

The conference proceedings clearly indicate that color measurement by visual inspection is being superseded in China by the use of measurement devices, some of which employ microprocessors. Thus, even though the new science of color optics got off to a relatively late start in China and we still lag behind the West considerably, the conference participants expect this gap to be closed quickly in time to meet the needs of China's four modernizations.

Related matters were also discussed at a separate meeting of color optics specialists held during the main conference.

It was decided that a third color optics symposium will be held at the same time next year.

12617
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APPLIED SCIENCES

SECOND NATIONAL SYMPOSIUM ON NEW LASER CRYSTALS HELD IN QUANZHOU

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese No 3, 1984 p 215
[Article by Yi Min [0044 3046] and Xiao San [5135 0005]]

[Text] The Second National Symposium on New Laser Crystals Materials, sponsored jointly by the Chinese Optical Society and the Chinese Silicate Society, was held from November 11 to 29, 1983, at Huaqiao University in Quanzhou, Fujian Province. Fifty-six delegates from 36 worker units in 9 provincial cities attended, along with 25 nonvoting delegates. Forty-six reports were presented, 11 in the plenary session, the remaining 35 at 3 different subgroup meetings.

At the plenary session, Assistant Professor Wo Xinneng [3087 5647 5174] of the Shanghai Optical Instrument Institute, Acta Sinica, briefly summarized the results of the 1983 International Laser Symposium in Guangzhou, which he regarded as fully up to prevailing international standards with respect to organization, technical level, and scope. Advanced engineer Zhang Yingxia [7022 5391 0204] of the Electronics Department of the Photoelectric Research Institute of Huabei University gave a report on the Seventh International Crystal Growth Symposium, which was attended by 16 Chinese representatives and dealt with the following four areas: 1) theoretical research in crystal growth and further progress in surface structure studies; 2) crystal growth techniques, with special attention given to automation; 3) growth of highly perfect crystals in the absence of distorting fields, with particular emphasis on crystal growth experiments in space; 4) crystalline semiconductors, epitaxial films, solar cells, and a host of other basic research areas. Assistant Professor Li Dening [2621 1795 1380] of the Shanghai Silicate Institute, Academica Sinica, reported on new directions in materials research. Assistant Professor Ma Xiaoshan [7456 4562 1472] of the Shanghai Optical Instrument Institute, Academica Sinica, discussed the development of laser crystals with terminal phonon transitions. Assistant Professor Shen Hongyuan [3088 7703 0337] of the Fujian Material Structure Institute, Academica Sinica, gave a talk on the selection and use of frequency-multiplying crystals. Lecturer Xu Chenghuang [6070 2110 2525] of the Chemistry Department of Huaqiao University, which hosted the conference, briefly described the state of research on color-center laser crystals.

The three subgroups dealt with the following areas: rare-earth and phonon-terminal laser crystals, color-center laser crystals, and nonlinear optical crystals. China has had some success in the area of laser crystals with terminal phonon transitions through its research on $\text{BeAl}_2\text{O}_4:\text{Cr}^{3+}$ and $\text{MgF}_2:\text{Ni}^{2+}$ crystals. Work on finding new types of crystals is under way at several locations and research will soon start on crystals obtained by doping phosphate-borate-molybdate host systems with Tb^{3+} , Ho^{3+} , and Er^{3+} . Small crystals with natural lasting activity and novel wavelength properties have already been grown. In addition, laser crystals which are already available (such as YAG, Er:YAP, Tb:GGG, Eu:GGG, Er:YLF, Ho:YLF, Ho:Er:Tm:YLF, etc.) are being used in experiments to increase laser power and produce lasting at new wavelengths. Research is also in progress on color-center laser crystals; for instance, much work has been done on the growth, coloring, optical rotation, spectrum, and color-center stability of crystals such as KCl:Li, KCl:Na, and KCl:Li:Na. Lithium fluoride color-center crystals with tunable pulsed lasing have been obtained at room temperature. Research has also begun on NaF:Mg^{2+} color-center laser crystals. In the area of nonlinear crystals, chemical bond parameter and crystallization techniques are being combined to statistically analyze crystalline materials containing calcium and titanium and determine their properties; these results will be useful in identifying new nonlinear and photocooustic crystals. China has developed several new nonlinear crystals, including sodium sulfosalicylate, L-AP, and barium metaborate. In addition, KTiOPo_4 crystals have been grown from melts and by an aqueous thermal process.

The conference members believe that China should strive to improve the quality of existing laser crystals while bringing new crystal materials into every-day use as quickly as possible. China's development of new laser crystals should be stimulated and accelerated through appropriate work allocation and cooperation among various work groups. Finally, it was recommended that methods be explored to implant new laser-active ions into existing crystals and that new laser crystal materials be sought through structural research and analysis.

The Third National Technical Symposium on New Laser Crystal Materials will be hosted by the Anhui Optical Instruments Institute, Academica Sinica, in Anhui Province in 1986.

12617
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APPLIED SCIENCES

NICKEL AND CHROMIUM FREE STAINLESS FOR MARINE APPLICATIONS

Beijing GANGTIE [IRON AND STEEL] in Chinese No 4, 1984 pp 70-72

[Article by Wei Zhenyu [7614 2182 1342]: "A New Type of Nickel-and Chromium-Free Stainless Steel for Marine Applications"]

Wear losses due to attrition by corrosive fluids are common in the industrial sector; fluid corrosion proofing is a topic given great emphasis by workers in material sciences today. In a paper entitled "A New Type of Ni-Cr-Free Stainless Steel for Marine Applications," in METAL PROGRESS (Vol 123, No 4, 1983), R. Warg and F.H. Beck examined the use of Ni-Cr-Free Fe-Mn-Al-Si stainless steel for the manufacture of propellers for ocean-going shipping. I will first introduce this as follows:

Many materials sciences workers, with an eye toward saving copper, have been studying the use of stainless steel alloys to replace bronze alloys for the making of ships' propellers, especially for ocean-going shipping. In most cases they have selected Ni-Cr stainless steel, but Ni and Cr have major strategic value, and their price is very high.

Since 1979 the authors have been studying the use of Ni-Cr-free stainless steel to replace bronze alloys in this application; after many materials development tests they have selected several compositions made up of the four elements of Fe, Mn, Al and Si. The data on this four-element steel is given below.

For strength, hardness and plasticity, Fe-30Mn-10Al-Si steel is superior to the bronze alloy commonly used in making propellers for ocean going ships. The specific gravity of this alloy is 22 percent less than that of bronze and it is lighter than Ni-Cr stainless steel. Fe-Mn-Al-Si alloy is better than bronze in this application.

Various Considerations in the Creation of Four Types of Composition

Al: If the Al content of the steel exceeds 8 percent, there will be excellent resistance to corrosion, but the Al content should not be allowed to go to high, the object being to obtain unitary phase austenitic steel with superior physical properties and resistance to corrosion. The range of Al content in the experimental materials varied from 5 to 12 percent.

Mn: For use as propeller material, there must be excellent physical properties as well as resistance to fluid corrosives. Austenitic steel manifests these two properties, so the alloy selected must be an austenitic structure. Mn is an element that stabilizes austenite.

Only when the Mn content is in the 20-35 percent range and the Al content is 5-12 percent will we see unitary phase austenitic structures. If the Mn content exceeds 30 percent then we have the relatively brittle Beta-Mn phase; the physical properties of the steel degenerate. The Mn content should be kept in the 20-30 percent range; then if the Al content is too high, there may be some ferrite in the structure, but no Beta-Mn phase.

C: This element is of no value in resisting sea water, as the graph in Figure 1 shows. But it is valuable in stabilizing austenite. When the C content is in the 0.5 to 0.7 percent range the rate of corrosion is the greatest. We have derived two different carbon ranges, $C \leq 0.5$ percent and $C=1$ percent.

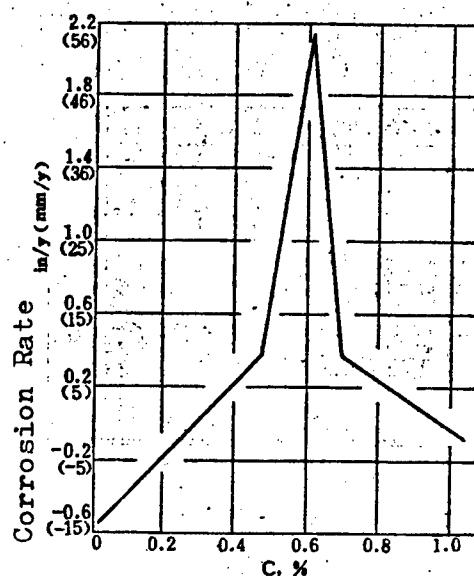


图 1 含碳量对钢的腐蚀速度影响

Figure 1: Effect of Carbon Content on Rate of Corrosion

Si: To investigate the effect of Si on salt water corrosion resistance, we experiment with two ranges of Si content, $Si \leq 0.3$ percent and $1 \text{ percent} < Si < 1.5$ percent.

Ranges of Alloy Composition

Al 5 to 12 percent; Mn 20 to 30 percent; Si \leq 0.3 percent or 1 percent $<$ Si $<$ 1.5 percent; C $<$ 0.5 percent or C about 1 percent.

All the experimental alloys were smelted in an electroslag furnace. Because propellers are generally not heat treated, all samples for the experiments on physical properties, microscopic analysis and tests on sea water corrosion were in the cast state. From the great number of experimental melts, four alloy compositions were sifted out. (See Table 1.)

Table 1: Typical Composition of Four Fe-Al-Mn-Si Alloys (Percents)

Alloy Name and Number	C	Si	Mn	Al	P	S	RE
1. 30Mn-10Al-Si	1.01	1.31	30.5	10.4	0.007	0.006	0.056
2. 20Mn-7Al	0.5	0.30	22.3	7.2	0.005	0.003	0.038
3. 30Mn-7Al-Si	0.23	1.25	29.2	7.4	0.008	0.003	0.060
4. 20Mn-5Al	0.13	0.28	20.7	5.6	0.007	0.006	0.063

Physical Properties of Four Kinds of Steel

Physical properties are compared with those of Mn-Fe Zinc Bronze in Table 2. The table shows that strength increases with the increase in C, Mn, and Al content, but the coefficient of elongation decreases with the increase of C, Al, Mn and especially Si. Generally speaking, since the samples were all in the cast state, certain physical properties could be upgraded. Heat treating would produce better qualities. The figures in Table 3 are provided for contrast.

Table 2: Physical Properties of Four Fe-Mn-Al Alloys in Comparison to Mn-Fe Bronze Alloy

Alloy Name and Number	TS, MPa	EI, %	Hardness		
			HRC	HRB	HB
1. 30Mn-10Al-Si	605	10	40	—	370
2. 20Mn-7Al	545	14	—	80	133
3. 30Mn-7Al-Si	550	11	—	84	—
4. 20Mn-5Al	510	15	—	86	—
5. Mn-Fe Bronze (65Cu-41Zn-3Mn-1Fe)	440	15	—	—	100

Table 3: Tensile Properties of Four Fe-Mn-Al Alloys¹

Composition	TS, MPa	YS, MPa	EI, %	RA, %
30Mn-8Al-1C	890	495	54	72
20Mn-10Al-1C	985	750	44	55
20Mn-5Al-1C	815	405	59	74
20Mn-5Al-0.1C	525	215	54	79

¹Measured at room temperature

Experiments on Sea Water Corrosion in Boiling Sea Water

To establish a comparison, experiments were carried out with the four types of Mn-Al-Si steel and one type of Ni-Cr stainless steel (0.08 C, 18.59 Cr, 9.63 Ni, 1.07 Ti) (a type of stainless steel with sea water corrosion properties similar to those of Mn-Fe Zinc Bronze) in boiling sea water.

During the experiment the purity of the sea water fluctuated constantly. After 118 hours in boiling sea water, sample 1 and the stainless steel sample showed no rust spots, sample 3 showed a few rust spots and samples 2 & 4 were definitely rusted.

Next, after immersion for 768 hours (32 days) in room temperature sea water, samples 2 & 4 exhibited a film of khaki-colored rust, and sample 3 was covered with a film of brown rust. The stainless steel sample showed some traces of rust but sample 1 exhibited no rust. These samples show clearly that alloy 1 (30Mn-10Al-Si) manifests excellent properties of resistance to sea water corrosion. (Figure 2 omitted.)

Figure 3 (omitted) shows SEM photographs of the surfaces of the four Mn-Al-Si-Si steel samples after 768 hours' immersion in sea water. The surfaces of samples 2, 3, & 4 clearly show rust. By comparison, sample 1 at the magnification of 500x shows only the marks left by machining.

Curves of Electrolytic Corrosion of Two Types of Alloy

Figure 4 shows the polarization curves of sample 1 (30Mn-10Al-Si) and 18Cr-9Ni-Ti stainless steel in man-made sea water. It is interesting that the electric current density (I_{corr}) of the two samples is very similar (2.905×10^3 nA/cm²). Because of the equivalent and density of sample 1 are lower than those of the 18Cr-9Ni-Ti stainless, sample 1's rate of corrosion is lower. That is to say that the rate of corrosion for 30Mn-10Al-Si is 1.205 mils/y (306 μ m/y), while the 18Cr-9Ni-Ti rate is 1.253 mils/y (31.8 μ m/y).

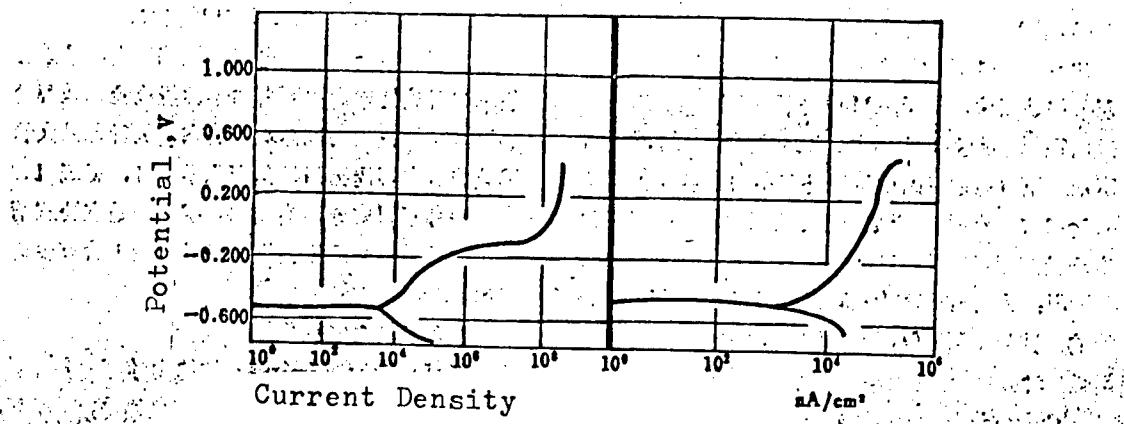


Figure 4: Polarization Curves of 30Mn-10Al-Si Steel (L) and 18Cr-9Ni-Ti Stainless Steel (R) in Man Made Sea Water

(L) $-I_{\text{Corr}} = 2.905 \times 10^8 \text{nA/cm}^2$, $R_{\text{Corr}} = 30.6 \mu\text{m/y}$, $E_{\text{Corr}} = -0.516\text{v}$ (R) $I_{\text{Corr}} = 2.905 \times 10^8 \text{nA/cm}^2$,
 $R_{\text{Corr}} = 3.18 \mu\text{m/y}$, $E_{\text{Corr}} = 0.444\text{v}$

Another interesting characteristic of Mn-Al-Si stainless steel is that it is not susceptible to stress corrosion cracking.

30Mn-10Al-Si for Propellers

Sample 1 manifests excellent characteristics of resistance to sea water and fluid corrosion. It is superior to the zinc bronze usually used in propellers for ocean going ships in the qualities of hardness and tensile strength. The microscopic structure of sample 1 in its cast state is the austenite matrix.

Alloy 1 was selected for the manufacture of propellers, the first one installed on a fishing vessel launched in August, 1980. That propeller was made at the China Mechanical Engineering Institute, Qingdao. Improvements in the makeup of alloy 1 should result in improvements in the behavior of physical properties and resistance to corrosion. Research work continues to progress.

12663
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APPLIED SCIENCES

MACHINE-BUILDING INDUSTRY SOCIETY HOLDS MEETING

Beijing JIXIE GONGYE ZIDONGHUA [MACHINE-BUILDING INDUSTRY AUTOMATION] in Chinese No 2, 1984 inside cover and p 64

[Article: "Chinese-Machine-Building Engineering Society Machine-Building Industry Automation Society's Second Annual Meeting Held in Dalian"]

[Text] Under the leadership of the China Machine-Building Industry Society, the Machine-Building Automation Society's second annual meeting was held in Dalian 20-25 October 1983. A total of 154 persons attended the meeting including the chair of the Board of Directors for the first year and the chair-elect for the second year, representatives of some provincial, municipal and autonomous region machine-building industry automation societies, representatives of specialist committees, paper givers and other representatives.

Comrade Zhang Zhang [1728 3864], deputy chair of the First Board of Directors, presided at the meeting and gave the opening address, and Comrade Cai Fuyuan [5591 4395 0337], secretary general and deputy chair, gave a summary of the work of the First Board of Directors.

This meeting completed the following four tasks:

1. Summarized the work of the past 4 years.

In the past 4 years, under the leadership of the China Machine-Building Industry Engineering Society and the specific leadership of Comrade Liu Ding [0491 7844] and due to the hard work of many scientific and technical workers and the comrades who participated in the work of various organizations of the society, the activities were launched in a comprehensive way, academic exchanges were lively, the areas touched on were broad and the boundaries between departments and areas were broken down in a preliminary way. A survey of the present state of China's machine-building industry automation and an exploration of the prospects were begun, the characteristics of China's machine-building industry's automation technology development and the proposals for related technical policies which were put forward were widely and highly regarded by the leadership and in other areas, and played an important role as reference materials in the formulation of policies and plans. In the past 4 years, many short training classes, study groups and technical forums have been held, education and training work has been started, specialist committees and local societies have started technical consulting service work for medium and small enterprises with good results. LIBRARY OF MACHINE-BUILDING INDUSTRY

AUTOMATION published has already exceeded 12,000 and it has been well received by readers. In terms of organization, based on the principle of gradually establishing and developing in initial activity, 6 specialist committees have already been established and subordinate to them 2 academic organizations; the All-China Higher Education Machine Processing Automation Research Society; 23 provinces, municipalities, and autonomous regions have set up local societies and study groups and laid a good organizational foundation for expanding study groups and laid a good organizational foundation for expanding activity. Practice proves that if we uphold seeking truth from facts and everything proceeds from actuality, taking advantage of the advantage of the society crossing departmental lines and having vertical and horizontal connections, developing academic democracy, increasing unity, opening channels, and pooling the wisdom of the masses, the society's work will certainly be able to play its proper role in the four modernizations.

Problems which now exist are: activity must still be deeper, quality and results need to be further improved, connections and coordination with local societies should be strengthened more, international academic exchange activity should be further developed. These are the things which need to be improved in the future.

2. Academic exchanges were carried out and how automation technology could better serve technological reform has been discussed.

There were 57 papers read at this meeting and over 30 kinds of resources were exchanged. They included policy-type problems and the development direction of machine-building industry automation and the application of automation technology in design, manufacture, testing and management, and exchanges of experience between society and teaching work. There were more papers dealing with new technological applications, especially the application of microcomputers, than there were at last year's meeting, the results of many have been put to work in production and technological reform and have secured technological and economic benefits.

Two special symposia, "Machine-Building Industry Automation Technology Policy" and "Automation Technology to Serve Technological Reform," were organized at the meeting, those who attended expressed their views and discussion was very enthusiastic. The main points were:

- (1) We should adapt to the needs of the strategic mission of "three ups and one improve" in the machine-building industry now and maintain seeking truth from facts.
- (2) We should make correct policy decisions and on the existing foundation we must further develop survey research in breadth and depth, and try to find out the existing situation and direction correctly and clearly.
- (3) In specific work we should uphold the principle of "walking on two legs," correctly handle the relationship between self-development and technology transfer and technology imports; the relationship between the long range and

the present; the relationship between priority projects and ordinary projects and between popularization and improvement; the relationship between technology and the economy; the relationship between theory and application; and the relationship between "soft" and "hard," i.e., between technology and the product, between development direction and technology and the product, between development direction and technology policy.

(4) We should strengthen education and training work: not only should we do a good job of training and education of employees, but we should also carry out talent surveys and be concerned about the specialist facilities, teaching plans and creation of teaching materials of various types of relevant schools.

(5) We should strengthen propaganda, for to develop automation technology it is necessary to improve people's knowledge, straighten out their thinking, and introduced exemplars; if we can put together some sound image materials, the results might be even better.

3. We elected a new chair of the Board of Directors.

According to the principles formulated by the China Machine-Building Engineering Society, after study and deliberation by the Standing Board of Directors and discussion with the departments concerned, the First Year Board of Directors chooses the Second Year Board of Directors from a group of 39. At the Second Meeting, the First Year Board of Directors selected 17 standing directors and chose Liu Ding as honorary chairman of the board, Zhang Zhang as chairman of the board, Zhang Hanying [1728 3352 5391], Wu Zhongling [0702 6945 7881], Gu Shenggu [7357 4939 6253], Yin Hanhe [7113 0698 0735], Cai Fuyuan, Zhang Guanghua [1728 1684 5478], and Lu Lin [0712 2651] as deputy chairmen, Cai Fuyuan as secretary general (concurrently), Zhang Guanghua and Tian Lianhui [3944 6647 2585] as deputy secretaries general (concurrently), and Ji Ruizhi [1323 3843 5347] as full-time deputy secretary general.

The Board of Directors also decided to set up three working committees and approved the list of committee members:

(1) Academic Committee: Made up of 11 persons, Zhang Guanghua is chairman, Lu Lin and Song Jianxing [1345 0494 5887] are deputy chairmen.

(2) Education Committee: Made up of 12 persons, Gushenggu is Chairman, Li Ren [2621 0088] and Wu Tianlin [0702 1131 2651] are deputy chairmen.

(3) Liaison Committee: Made up of 11 persons from concerned units, Zhang Yijun [1728 0110 6874] is chairman and Han Da [7281 6671] and Huang Yuzhu [7806 7183 4376] are deputy chairmen.

The original specialist study groups were renamed specialist committees, and the original members will continue to serve; there may also be adjustments depending on the specific circumstances.

4. Important points for the activities of next year's society were raised.

Next year's society activity should center on "Automation Technology in the Service of Technological Reform" to promote technological progress and improvement of enterprise quality.

(1) Further improve the quality and level of academic exchange and strive for results. Future national academic exchange activity will be primarily by the specialist committees to strengthen joint activity with fraternal and local societies.

(2) Give on-the-job training work an important place in the activities of the society to promote updating knowledge; we should regard improvement high and regard popularization even more highly. Depending on specific conditions and demands, we should take such generally necessary new technology as electronic and hydraulic technology and computer applications, especially microcomputer applications, as points of emphasis and offer technical forums, study groups or reports on special topics.

(3) On the basis of the needs of grassroots-level units, especially technological consultation and service in a variety of forms and constantly summarize experience.

(4) Continue to stress the editing and publishing of the LIBRARY OF MACHINE-BUILDING AUTOMATION TECHNOLOGY, strive to improve the quality of periodicals, organize the editing and publishing of popular practical technological books and magazines in the areas of electronics and automation.

(5) Undertake international academic exchange activity, and try to establish contact with corresponding international academic organizations.

(6) Continue to plunge into developing survey research, clarify the basic situation and demands, conduct technological and economic analyses, research how to develop further the advisory role of the society.

(7) Further strengthen organization building and complete the building of the three work committees. Establish the necessary work and meeting system to take better advantage of the Board of Directors.

(8) Uphold and develop the society's excellent style of seeking truth from facts, letting a hundred schools contend, unity and cooperation and linking up theory and practice in survey research.

This year's meeting concluded on 25 October. At the closing ceremonies, Chairman of the Board Zhang Zhang gave the closing address and issued certificates to the First Years Directors, thanking them for their hard work for the society.

APPLIED SCIENCES

OFF-WALL ROCK LININGS FOR UNDERGROUND STRUCTURES

Chongqing DIXIA GONGCHENG [UNDERGROUND ENGINEERING] in Chinese No 12, 1983
pp 18-19

[Excerpt from article: "Off-Wall Rock Linings for Underground Structures--
Samples of Linings Applied to Several Underground Projects in the Country"]

[TABLE]

Number 1

Project Name

Movie theater, Zhejiang Province

Form of Lining

Gunited anchor-supported, off-wall lining

Walls: Pre-fabricated concrete sections in the shape of the Greek letter
"pi", grouted with concrete

Arch: Continuous-poured reinforcing bar-concrete arch ribs -- pre-fab-
ricated rebar-concrete beams and rebar-concrete slabs cast on site.

Section Characteristics

Gross span of tunnel: 23.8 meters

Lining span: 20 meters

Height: 16 meters

Rise of Arch: 10 meters

Distance from wall: 0.8 to 12 meters

Features of Surrounding Rock

Jurassic rhyolite and tuff; fairly intact, places with faces of weak composition

Notes

Has been placed in use

Number 2

Project Name

Experimental military tunnel

Form of Lining

Gunited anchor - supported, off-wall lining

Walls: Laid-up brick type

Roof: Pre-fabricated rebar-concrete grooved slabs (space above roof also serves for equipment and natural ventilation pipe)

Section Characteristics

Gross tunnel span: 6 meters

Lining span: 5.4 meters

Height: 5 meters

Rise of arch: 2.8 meters

Distance from wall: 16 cm on one side; 8 cm on the other

Features of Surrounding Rock

Stratified calcareous sandstone, fairly fractured, cracks developed, crevice water present

Notes

Has been placed in use

Number 3

Project Name

Motion picture production studio, three-line project

Form of Lining

Form cast concrete lining tiles, off-wall lining

Walls: Laid-up masonry walls

Roof: Cast on-site rebar-concrete beam-slab type (space above roof also serves for equipment and natural ventilation pipe)

Section Characteristics

Gross tunnel span: 7.1 meters

Lining span: 6 meters

Height: 6 meters

Rise of arch: 2.8 meters

Distance from wall: 12 cm

Features of Surrounding Rock

Calcareous sandstone, carbonized shale, fissure development, corrosion and weathering phenomena

Notes

Has been placed in use

Number 4

Project Name

Communication project

Form of Lining

Gunited anchor - supported, off-wall lining

Section Characteristics

Gross tunnel span: 16.6 meters

Lining span: 14 meters

Height: 8 meters

Rise of arch: 3.8 meters

Distance from wall: 48 cm on one side, 1.2 meters on the other (also serving as conduit passage)

Features of Surrounding Rock

Stratified calcerous sandstone, fissures fairly developed

Notes

Under construction

Number 5

Project Name

Wutai Shan civil defense project

Form of Lining

Gunited anchor - supported, half-off-wall lining

Walls: Laid masonry type; plastered type

Arch: Pre-fabricated rebar-concrete hyperbolic arch, off-wall type

Section Characteristics

Gross tunnel span: 4 meters

Lining span: 3 meters

Height: 4 meters

Rise of arch: 1.65 meters

Distance from wall: 0.8 to 1 meter

Features of Surrounding Rock

Third epoch weatherized Chishan sandstone

Notes

Work completed, part put into use

Number 6

Project Name

Project of a Naval fleet

Form of Lining

Gunited anchor - supported, off-wall lining

Walls: Pre-fabricated hollow concrete masonry block

Arch: Pre-fabricated rebar-concrete arch-shaped grooved slabs (two pieces fitted together)

Section Characteristics

Gross tunnel span: 10.5 meters

Lining span: 9 meters

Height: 4.8 meters

Rise of arch: 1.6 meters

Distance from wall: 0.5 meters

Features of Surrounding Rock

Coarse-grained granite, fairly intact, places with weathering phenomena

Notes

Already in use

Number 7

Project Name

Air Force petroleum dump at a certain Military Region

Form of Lining

Form-cast rebar-concrete lining blocks, semi-off-wall lining

Walls: Pre-fabricated steel-mesh wire cement lining slabs (tongue and groove), off-wall type

Roof: Not yet built, it will be mold-cast rebar-concrete tank cap type

Section Characteristics

Span (tank diameter): 16.8 meters

Wall height: 10.63 meters

Distance from wall: 6 cm

Features of Surrounding Rock

Calcareous sandstone, fractured, severe weathering, joints extremely developed, corroded pockets

Notes

Under construction (part of the work has been finished)

Number 8

Project Name

Navigation stores warehouse at a certain Air Force field

Form of Lining

Gunit anchor - supported, off-wall lining

Walls: Pre-fabricated rebar-concrete grooved slab

Arch: Pre-fabricated rebar-concrete grooved slab (laid together in the shape of an inverted "V")

Section Characteristics

Gross tunnel span: 9 meters

Lining span: 8 meters

Height: 6.85 meters

Rise of arch: 3.75 meters

Distance from wall: 40 cm

Features of Surrounding Rock

Medium-hard calcareous sandstone, no underground water, joints fairly developed

Notes

In use

Number 9

Project Name

Warehouse of a certain Naval squadron

Form of Lining

Gunited anchor - supported, off-wall lining

Walls: Form-cast concrete walls

Arch: Form-cast rebar-concrete arch structure

Section Characteristics

Gross tunnel span: 11 meters

Lining span: 9 meters

Height: 6.9 meters

Rise of arch: 3 meters

Distance from wall: 0.54 meters

Features of Surrounding Rock

Calcareous sandstone, joints fairly developed

Notes

In use

12663

CSO: 4008/252

VIBRATION PROBLEMS IN SATELLITES OF COMPOSITE STRUCTURE

Harbin DIZHEN GONGCHENG YU GONGCHENG ZHENDONG [EARTHQUAKE ENGINEERING AND ENGINEERING VIBRATION] in Chinese No 4, 1983 pp 102-107

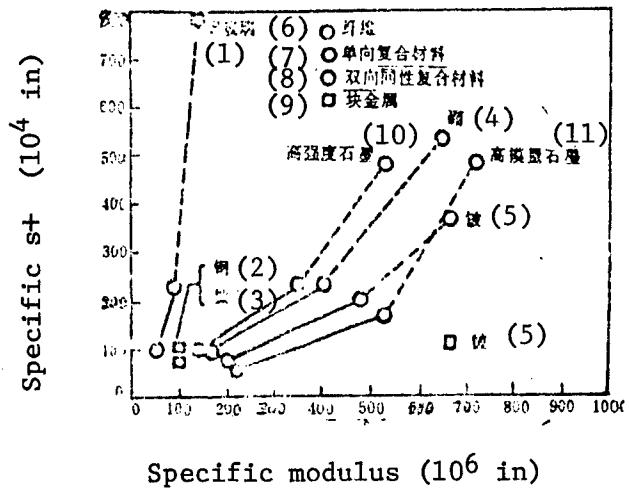
[Article by Zhang Jidong [1728 4949 2767] of the Institute of Engineering Mechanics]

[Text] I. Composite Materials Are Potential Structural Materials for Man-made Satellites

The environments encountered by an earth satellite include the launching environment, the orbit flight and the reentry into the atmosphere. In the launching situation, the satellite experiences very large acceleration overload and strong vibrations, therefore, the structural material must have sufficient strength. In order to avoid resonance between the satellite and the carrier system, they should have very different characteristic frequencies and the satellite structure must have adequate rigidity. Since most satellites have a thin-walled structure, the structural material must have a high modulus of elasticity. High damping materials are desirable in the minimization of the dynamic response. These put high demands on the strength. In the orbit flight stage the satellite is situated in a cyclic high and low temperature environment and the temperature change may be as high as 200°C or more¹. Certain satellite components (such as the microwave antenna) require very high accuracy in their dimensions and the thermal deformation should be as small as possible. The structural material should therefore have as small a thermal expansion coefficient as possible. Other satellite components such as the solar array have an open structure and must be rigid enough in order to avoid interference with the attitude control of the satellite. In addition, satellite structural materials should also be stable under high vacuum and under the radiation of particles and ultraviolet. During the reentry into the atmosphere the satellite is in a high temperature environment and requires thermal shield design. As the weight of a satellite increases, it requires a greater thrust and the total weight of the multistage rocket increases rapidly. The need to reduce the weight of the satellite is therefore even more crucial than that of the aeronautical structures. The satellite structure should therefore have a low density. To sum it up, satellite structural materials are expected to have a high elastic modulus, a low thermal expansion coefficient, high strength, and low density.

Figure 1 shows a comparison of the performance² of common aerospace structural materials with that of several major types of fiber-reinforced components.

Figure 1.



- KEY:
- | | |
|---------------|------------------------------|
| (1) S-glass | (7) Unidirectional composite |
| (2) Steel | (8) Bidirectional composite |
| (3) Titanium | (9) Bulk metal |
| (4) Boron | (10) High strength graphite |
| (5) Beryllium | (11) High modulus graphite |
| (6) Fiber | |

As can be seen, the performance of the conventional aluminum-magnesium alloy material used in the aerospace industry is relatively poor and will gradually be replaced by the new structural materials. Beryllium has a high modulus and other good mechanical properties and has been used in satellite structures, but it is hard to machine and the cost is high. In particular, the pollution (toxicity) problem associated with beryllium limits its application. Titanium alloy have superior heat-resistant properties and their application in the aerospace industry has matured. However, the specific rigidity and the specific strength of titanium are both lower than that of the new composite materials. The new composite materials generally refer to carbon (graphite) fiber composite, boron fiber composite and Kevlar fiber composite. They have a high specific strength and a high specific rigidity. Resin-based components also have a high damping and a low coefficient of thermal expansion. These are the unique advantages of composite materials. Taking advantage of the property that some reinforcing fibers have a negative coefficient of thermal expansion, composite materials may be fabricated to possess the desired coefficient of thermal expansion (including zero) along different directions by the proper choice of the fibers, the layup method and the resin content³. The designability of the mechanical property is a unique advantage of composite materials. It provides the design engineer more degrees of freedom in the optimization of the structural design of satellites. While satisfying the structural requirements, the weight of the satellite may be reduced to a minimum.

The above analysis shows that the characteristics of the new composite materials exactly coincide with the structural material requirements of satellites and other aerospace structures. They are therefore potentially good structural materials for satellites and they have already been widely used in foreign countries⁴. Space and aeronautical industries are the prime movers for the birth and growth of composites which in turn play a leading role in their application in aerospace structures. Today composites are widely used as main stress-bearing members.

Glass-epoxy composites have a low modulus of elasticity and are not suitable as main stress members of a satellite. Boron-epoxy and boron-aluminum have higher specific modulus and specific strength, and the latter is also good for high temperature applications. They are potentially useful materials, but their applications are somewhat limited by the complex fabrication procedures. Kevlar-epoxy composites have a high specific strength and a low thermal expansion coefficient, but their specific modulus and compression strength are low, which limit their application to some extent. The major structural materials for aerospace components, including satellites, are therefore carbon fiber composites, more specifically, high modulus graphite fiber composites.

II. Analysis and Design of Satellite Structure

The main structures of the satellite system are the satellite body and the solar cell array. For microwave transmission satellites, there is also the antenna structure.

1. Satellite body structure

Using the Japanese ETS-1 satellite⁵ as an example, we will now discuss the analysis and design considerations of the main body structure of the satellite.

The shell of the ETS-1 satellite is a 26-faced polyhedron with a circumscribing sphere 80 cm in diameter. The main interior structures are thrust tube, the equipment rack and frame, and the separator ring. The thrust tube is a cylindrical structure made of 1 mm thick aluminum alloy. It is the main loading member and supports the equipment rack and the solar array. The equipment rack is made of aluminum alloy and has a honeycomb structure that holds the equipment in place. The frame of the rack consists of aluminum alloy I-beams. The separator ring is made of forged aluminum alloy and it interfaces the satellite and the rocket hold-down devices.

The stage that determines the structural design of the satellite is the launching stage, including the entire process prior to entering the orbit. Table 1 shows the mechanical parameters for this stage. The maximum load and the combination thereof that may be encountered by a structural component is known as the critical load. The limiting load is obtained by multiplying the critical load by the safety factor, taken to be 1.5. Criteria for satellite design are that no permanent deformation is allowed at the critical load and no fracture or other form of failure is allowed at the limiting load. All

components must have adequate rigidity so that the deformation at critical load will not cause contact or interference between the various components of the satellite and between the satellite and the cowling. The axial fundamental frequency of the satellite is 40 Hz and the transverse frequency is 25 Hz. These frequencies avoid coincidence with the fundamental frequency of the booster. The mechanical analysis of the satellite body is done using a finite element model with 254 units, 68 nodes and 180 degrees of freedom. In addition to the modelling, experiments were also done using the limiting state parameters. Sinusoidal vibration and random vibration experiments were conducted on a vibration table for the X (launching), Y and Z direction.

2. Solar cell array

Solar cell array is an indispensable energy source in the long flight of a satellite. Each square meter of photocell produces approximately 0.1-0.15 kilowatts of electrical energy. In the development of aerospace technology, the equipment and devices on the satellite require more and more electric power and larger solar cell arrays. Moreover, with the successful development of the space shuttle, the possibility for the solar power station (SPS) has also increased. A solar power station⁶ is a geosynchronous man-made satellite that produces electric energy from solar energy and transmits the electric energy to the earth surface via microwave radiation. The main body of a SPS is the solar array. In the studied proposals, the dimension of the solar array will be 21,280x5,300x470 m³. The parabolic microwave radiator will be a right hexagon 1000 meters across. This system will provide 5-10 million kilowatts of electric power.

The main requirements of the solar array structural design⁷ are: maximum unfolded area, light weight, reliable unfolding operation, high eigenfrequency for bending vibration (i.e., maximum bending rigidity), and not interfering with the attitude control of the satellite. The eigenfrequency for bending vibration of an unfolded solar array is usually required to be greater than 0.1 Hz and the fundamental frequency of the folded array should not resonate with the satellite.

Solar arrays have the following structural types⁷: (1) Rigid or honeycomb sandwich structures made of aluminum honeycomb and the aluminum face plates or aluminum honeycomb and graphite-epoxy face plates. If such structures are reinforced with a rigid frame, the honeycomb grid size may be increased and the thickness of the face plates may be reduced so that the total weight is reduced while adequate rigidity is maintained. Such a reinforced honeycomb sandwich is still considered a rigid array structure. (2) Flexible structure on a rigid frame, that is prestretched film on a rigid frame. This may be called a semi-rigid structure. (3) Flexible structure in the form of thin films that can be folded up like an accordian or rolled up into a cylinder. Since the flexible structure is even lighter than the rigid structure, it is the direction for development. (4) Hybrid structure consisting of mostly flexible structure and some rigid structure. The unique feature of the hybrid structure is that, before the satellite enters the final orbit and opens up the main solar array, an auxiliary rigid array may

Table 1.

Stimulosoidal Vibration		Impact		Quasi-static Acceleration	
Direction	Freq. (Hz)	Acc. (g, o-p)	Direction	Acc.	Spin
Launch direction	5-17 17-23 23-150 250-400 400-2000	1.5 4.5 1.5 3.0 5.0			3.75 - 75 75 - 150 150 - 300 300 - 600 600 - 1200
Lateral	5-14 14-250 250-400 400-2000	2.7 1.0 3.0 5.0			Notes 1200 - 2400 2400 - 4800 4800 - 9600 higher
Axis					2 Hz
Launch direction	+	20 10			15g

Table 2.

Model	Structure	Opening Method	Eigenfreq (Hz) unfolded	Eigenfreq (Hz) folded	Total Weight (kg)	Total Power (kw)
SkyLab	Rigid	Folding				13
ELTSATCOM	Rigid	Folding	0.32	25	90	1.8
MATRA	Rigid	Folding				1.3
TDRSS	Rigid	Folding	0.5			3.1
Intelsat V	Rigid	Folding	0.36	34		1.7
ULP	Rigid	Folding	0.3	24		1.6
Aerospatiale	Rigid	Folding	0.28	46		1.1
CTS	Flexible	Folding	0.32	46		1.3
CEPS	Flexible	Folding	0.04			25
ERUSA	Flexible	Roll up	0.25		31.7	1.3
DORA	Flexible	Roll up	0.17			9.0
Space Telescope	Flexible	Roll up			182.3	4.5
ESA-IHSA	Hybrid	Folding				6.3
SPAR-MPDHSA	Hybrid	Folding	0.10			2.1

be opened first to satisfy the power needs in that stage. For geosynchronous satellites the hybrid structure is more appropriate.

Table 2 shows a selection of foreign satellite solar array data⁷. The solar array developed in China uses carbon-epoxy and a rigid structural design. Using a concentrated mass method, the eigenfrequency and vibration modes of the Chinese solar array are analyzed. In addition to analysis and computation, vibration experiments were also performed.

3. Parabolic antenna structure

Using the scanning multichannel microwave radiator (SMMR) of the American satellite Nimbus-G/Seasat-A as an example⁸, we will now discuss structural analysis and design considerations.

The SMMR is a revolitional parabolic thin shell with a diameter of 79 cm and a thickness of 0.76 mm, reinforced by six angle beams of I-shaped crosssection arranged in the form of a six-pointed star. It is propped up by six hexagonal-crosssection bracing struts. The entire structure, with the exception of the aluminum alloy portal frame and the strut nodal points, is made of graphite-epoxy composite. The dimension and design specifications are listed in Table 3.

Table 3.

	<u>Structure</u>	<u>Profile</u>	<u>Reflection frequency</u>
Internal load	50 g	Size of reflector	revolitional parabolic surface focal length 45 cm
Dynamic load	5g (sine)		Frequency: 6.6-37 GHz
Moment of inertia	0.56 kg-m ²	diameter 79cm	Manufacture tolerance 0.008 cm (rms)
Dynanic equilibrium	Residual angular momentum 0.006 kg-m ² / sec	axis of rotation	42° from the axis of symmetry 0.1 cm, on orbit
Fundamental frequency	70 Hz	Scan angle	±29°
Weight	5.7 kg		

A finite element model was used in the static and dynamic stress analysis. The static and dynamic stress distributions were calculated by applying 50 g of acceleration on the three mutually orthogonal S/C coordinates. Under the action of a 5g sinusoidal external force, the dynamic response and dynamic stress distribution of the structure and the eigenfrequency were calculated. The dimensions of the calculation model fully reflect the geometric shape of the set-over parabolic reflector and the elastic center connecting the off-center, the supporting structure and the shell body. The computation model used 143 platte elements (triangular and rectangular) and 135 bent beam elements. Material anisotropy of the components (wing edge and web plate of the I-beam, reflector shell, bracing strut and support members) was taken into account. The maximum stress was found in the static analysis. In the vibration analysis a damping coefficient of 1.5 percent was assumed for the critical damping of the structure.

Vibration experiments were also conducted. Eigenfrequency and dynamic responses were measured in the three orthogonal directions. The fundamental frequency of the lateral vibration was measured to be 77 Hz and calculated to be 88 Hz.

III. Problems To Be Studied

From the above analysis we may draw the following conclusions: fiber composites may become the principal structural material of man-made satellites and the vibration problem during launching is the main consideration in the satellite structural design. Therefore, in terms of research of the structural dynamics of composite materials, the analysis and design of the satellite structure is an appropriate topic tied to realities.

In the current stage of progress, the following problems need further investigation:

1. The vibration problem of typical structural components with complex mechanical properties:

Examples are the vibration of sandwich plates and shells made of fiber reinforced composites and reinforced with composite ribs, and the vibration of rigid and flexible solar array plates. In such an investigation, the anisotropy, inhomogeneity (multiphase nature) and damping of the composite material must be taken into consideration.

2. Vibration analysis of complex structures made of composite materials:

Discretization methods such as the finite element method should be developed for high accuracy and rapid computation. The complex nature of the composite materials should be addressed in the calculation and experimental techniques should be investigated to study the complex structures.

3. Dynamic mechanical studies of fiber composite materials (mainly the graphite fiber composite):

Based on literature data and our own experimental results,⁹ there is a difference between the dynamic modulus and the static modulus of resin based composites. Its damping is also large. Dynamic modulus of fiber composite material should be measured accurately. Some unresolved problems still remain in this area. Theory and measurement methods for fiber composite materials should be studied.

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9698
CSO: 4008/242

Aerodynamics

AUTHOR: JI Chuqun [4764 2806 5028]

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TITLE: "A Numerical Computation for the Inviscid Supersonic Flow Around Bent Cone"

SOURCE: Mianyang DAQI DONGLIXUE [ACTA AERODYNAMICA SINICA] in Chinese No 1, 1984 pp 29-39

TEXT OF ENGLISH ABSTRACT: A numerical computation method for the inviscid supersonic flow around a bent cone is given in this paper by using the finite difference method and shock-capturing technique. In order to overcome the difficulty due to the bend of the bent cone axis in the advanced process solving equation, the solving plane of Euler's equation is considered as an inclined plane with the advanced direction using a transform of the equation's independent variables. The second order, two-step MacCormack scheme is used. The equation system for boundary computation is derived according to the characteristic compatibility relations on body surface or shock wave and corresponding boundary condition. The flow properties of the singular points on the intersected line between two cone surfaces are solved individually. The non-uniform computation meshes along the direction of the body radius are used in order to raise the computation accuracy when the gradient of the entropy near the body surface is very large. The computation results in many numerical examples indicate that good results can be obtained by means of this method.

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TITLE: "The Engineering Numerical Technique for the Determination of the Inviscid Flow Field and Heating Rate on Ballistic Re-entry Vehicles"

SOURCE: Mianyang DAQI DONGLIXUE [ACTA AERODYNAMICA SINICA] in Chinese No 1, 1984 pp 56-63

TEXT OF ENGLISH ABSTRACT: The Ballistic Re-entry Vehicle's Shock Pressure and Heating Rate Computer Code (RVSPHR) is of an approximate numerical technique for the determination of the inviscid aerodynamics and heat transfer of re-entry vehicles. In the transonic flow region surrounding the nose stagnation point, body surface pressures and shock angles are assigned from the correlation. Assumptions for the profiles of pressure and normal velocity along body-normals in Von Mises coordinates are made, and a local iteration is carried out at each normal to locate the shock position with the mass continuity satisfied along that normal. In this flow region, it excludes the flow problem which is elliptic and has to be solved by an iterative numerical procedure, so that much less computer time is required than by more rigorous solutions.

In supersonic regions, the exact Euler equations of motion are integrated using the finite difference method. The required initial data for these calculations are obtained from approximate transonic solutions. Based on inviscid calculations, we calculate the surface heating rate, using a non-iterative entropy swallowing calculation code.

All calculated results, consisting of shock shape, surface pressure distribution and flow field profiles through the shock layer and surface heating rate distribution, are compared with more rigorous solutions and experimental data, and good agreements are found.

9717
CSO: 4009/125

CHEMISTRY

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TITLE: "Polarographic Catalytic Determination of Ultra Microamount Tungsten
in Sea Water"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese No 2,
20 Feb 84 pp 84-89

TEXT OF ENGLISH ABSTRACT: The best supporting electrolyte for the titled method to determine tungsten in sea water is sodium chloride solution containing 0.03M hydrochloric acid and 2.0×10^{-4} M benzilic acid. The catalytic wave appears with peak potential between -1.1 V and -1.2 V (vs.S.C.E.). The limit of detection for tungsten is 5×10^{-12} M. The method is rapid, simple, sensitive and accurate. It can also be applied to determine tungsten in estuarine water, tap water and well water.

9717 CSO: 4009/67

CHEMISTRY

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TITLE: "The Degree of Crystallinity of Cis-PB (1,4-Polybutadiene) Polymerized with Lanthanides Catalysts"

SOURCE: Changchun YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese No 3, Jun 84 pp 19-23

TEXT OF ENGLISH ABSTRACT: Based on the X-ray scattering intensity theory, the correction factors of crystallinity formulae of polymers have been clearly defined. The crystallinity formulae of the cis-1,4 PB was derived in terms of the WAXD [wide-angle X-ray diffraction] curves of polymers by graphic multi-peak resolution methods. The crystallinity of other crystalline polymers can be easily evaluated by our method.

9717

CSO: 4009/127

CHEMISTRY

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TITLE: "Cooligomer Composition Controlling in the Cooligomerization of Acrylonitrile and Butadiene"

SOURCE: Changchun YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese No 3, Jun 84 pp 29-35

TEXT OF ENGLISH ABSTRACT: In preparing copolymer with homogeneous composition by batch process in two-component copolymerization reaction, it is necessary to keep the monomer ratio constant by replenishing the fraction of the more reactive monomer. A calculation method of monomer feeding, capable of controlling the composition of cooligomer during the course of reaction, is derived. Some cooligomers of acrylonitrile and butadiene with comparatively homogeneous compositions have been prepared using this replenishing method. This method would be useful for other two-component copolymerization processes.

9717
CSO: 4009/127

CHEMISTRY

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TITLE: "The Fourier Transform Infrared Spectra of 15 Rare Earth-EHPAEH Complexes"

SOURCE: Changchun YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese No 3, Jun 84 pp 36-40

TEXT OF ENGLISH ABSTRACT: 2-Ethylhexylphosphonic acid mono(2-ethylhexyl) ester (EHPAEH) is a more effective extractant than D2EHPA for extraction of rare earths. Fifteen solid and solution rare earth-EHPAEH complexes in kerosene have been prepared and their FT-IR spectra have also been studied using a subtraction technique.

In the FT-IR subtraction spectra of either the extracted species in the organic phase or the solid complexes, a positive peak and a negative one were observed corresponding to $\nu_{P=O \rightarrow M}$, $\nu_{P=O}$ respectively, or to ν_{P-O-M} and ν_{P-O-H} respectively.

The variations of $\nu_{P=O \rightarrow M}$, ν_{P-O-M} and ν_{O-M} (150 cm^{-1}) with the atomic number of lanthanides were plotted for the solid complexes. These curves show an obvious "tetrad effect," Y being located between Er and Tm.

9717

CSO: 4009/127

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TITLE: "Pressure Fluid Extraction of Heavy Products From Coal Liquids"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND
TECHNOLOGY] in Chinese Vol 11, No 3, Sept 83, pp 16-23

ABSTRACT: The coal liquid contains heavy liquid products as well as solid organics and minerals. The effective separation and recovery of these heavy products has attracted worldwide attention. Kerr-McGee developed a critical solvent deashing (CSD) process. An ash yield of 0.09 percent in solvent refined coal (SRC) products extracted by the CSD process was reported. In fact an effective extraction process can be realized in a non-critical state. Therefore, the technology should be called pressure fluid extraction. The raw materials used included the vacuum still bottom and hydrocyclone underflow of the hydrogen-coal process plant in Trenton, N.J., as well as materials obtained by the SRC method provided by Kerr-McGee. A semi-continuous laboratory extraction apparatus was built and the process is shown in Figure 1. The pressure extracting vessel (Figure 2) was a 100 ml stainless vessel, 19 mm in inner diameter and 9.5 mm in wall thickness. The upper part of the apparatus was equipped with a 12.7 mm inner diameter cylinder which was made of 316 SS with 40 micron diameter pores. The extraction was performed at 100 atm and 350 °C for 1 hour, n-nonane, toluene, p-xylene, ethylbenzene, tetrahydrofuren, p-cresol and pyridine were employed as solvents. The solvent flow rate was 9.9 ml/min. The analysis was done according to ASTM standards. A CARLO ERBA 1106 element analyzer was used for the microanalysis of carbon, hydrogen and nitrogen. A Fisher 475 sulfur analyzer was used to measure sulfur. Results indicated that pressure fluid extraction could effectively separate heavy products in coal liquids into liquids with ash contents below 0.05 percent and ash-rich solid residuals. Toluene, ethylbenzene and p-xylene were more suited as solvents for pressure fluid extraction at 350 °C under 100 atm and 94-98 percent of the pyridine soluble materials in the coal liquid could be recovered. The PFE yield was higher than that in the Soxhlet apparatus

using the same aromatic hydrocarbon solvents such as toluene. This indicated that some of the toluene insoluble species in the coal liquid might be converted into toluene soluble products in the PFE process. The Hildebrand solubility parameter alone was unable to predict the extraction capability of a solvent. Other factors, such as molecular interaction between solvent and extracted materials, must be taken into account in studying the solvent efficiency.

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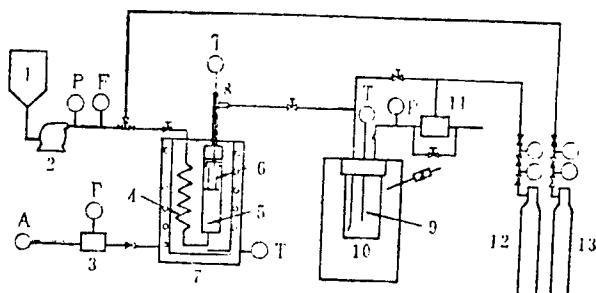


Figure 1. Experimental Apparatus

- | | |
|-----------------------------------|---------------------------------|
| 1 - solvent container | 2 - high-pressure metering pump |
| 3 - compressed air filter | 4 - solvent preheater |
| 5 - pressure extracting apparatus | 6 - raw material cylinder |
| 7 - fluidized sand bath furnace | 8 - outlet |
| 9 - extract receiver | 10 - ice water cooling tank |
| 11 - pressure regulator | 12 - low-pressure nitrogen tank |
| 13 - high-pressure nitrogen tank | |
| T - temperature gauge | |
| P - pressure gauge | |
| F - flow meter | |
| A - compressed air | |

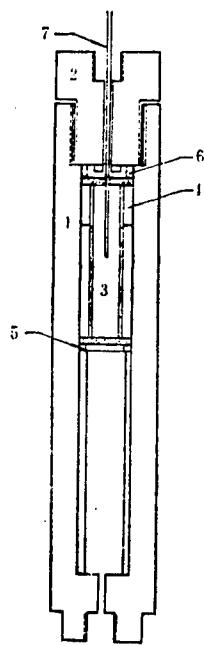


Figure 2. Schematic Diagram of
the Pressure Extractor

- 1 - pressure extractor
- 2 - top cover
- 3 - material holder
- 4 - holder cap
- 5 - annular support
- 6 - sealing ring
- 7 - thermocouple tube

12553
CSO: 4009/12

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ORG: All of Department of Thermophysical Engineering, Zhejiang University

TITLE: "Characteristics of Coal - Oil - Mixture Combustion"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol II, No 3, Sep 83, pp 1-10.

ABSTRACT: As an effective transitional measure to conserve fuel, the combustion of Coal - Oil - Mixture (COM) and Coal-Oil - Water - Mixture (COWM) has received considerable attention. The ignition and combustion characteristics were studied experimentally using a single droplet combustion test and a COM spray combustion method. In the single droplet combustion experiment, the specimen was suspended on a thermocouple or quartz wire in a high temperature furnace where the temperature could be automatically controlled. The temperature rise of the droplet was recorded. The entire combustion process was photographed by a high speed movie camera (50 frames/sec). Specimens from various characteristic stages were analyzed using optical and scanning electron microscopy. The COM spray combustion test was carried out in a cylindrical combustion chamber. The temperature distribution, smoke composition distribution, gravimetric flow and combustible content distribution in the chamber were measured. The residual oil used in this work came from Daqing and the coal powder was from Pingdingshan. The so-called ignition temperature is the internal temperature of the droplet at ignition. It decreased with increasing furnace temperature when the coal content was below 45 percent. As the furnace temperature reached over 750 °C, it was almost unaffected by the furnace temperature and remained at 335 °C. The ignition temperature of COM with under 45 percent coal was determined by the property of the residual oil. The droplet was a mechanical mixture of coal powder surrounded and permeated by residual oil. The water content in COM significantly affected the ignition characteristics. A COWM (coal : oil : water = 45.5 : 49.5 : 10) exhibited a double ignition effect. The COWM ignition temperature was found to be lower than that of COM and the COWM ignition time was also shorter than that of COM. Because the thermal diffusivity of 45 percent COM is higher than that of residual oil, the ignition time of COM is also shorter. A semi-empirical expression was used to calculate the ignition time in an actual COM spray combustion.

When the average particle diameter was $87.2\mu\text{m}$ it was 17 milliseconds at $1,200^\circ\text{C}$, in agreement with the actual measurement. The combustion process of COM was analyzed. It was divided into three stages: preheating stage, flame diffusion stage, and cell combustion stage. The combustion rate was found to increase gradually at below $1,200^\circ\text{C}$. Above $1,200^\circ\text{C}$, the increase became drastically more rapid. The combustion rate of 45 percent COM was between that of residual oil and coal. In conclusion, the ignition temperature of COM (below 45 percent) is the same as that of residual oil. Its ignition time is shortened due to the high thermal diffusivity of coal powder. If the amortization mass is maintained properly, ignition of COM is not a problem. The combustion rate of COM is much faster than that of pure coal powder. The addition of an appropriate amount of water to emulsify the COM can improve the amortization mass, which will benefit ignition, reduce coke formation and improve combustion rate.

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12553
CSO: 4009/12

Geology

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TITLE: "Discussion of Results of the Uranium-Series Intercomparison Project"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA] in Chinese No 1, 1984
p 25

TEXT OF ENGLISH ABSTRACT: The Phases I, II and III of the Uranium-Series Intercomparison Project (USIP) consist of the analysis of some natural carbonate samples by laboratories in different countries, checking against systematic errors in the procedure and age calculation, and prove the valid analytical technique for dating by U-series geochronology.

A statistical analysis of USIP results of Phases I, II and III, including U contents, $^{230}\text{Th}/^{234}\text{U}$, $^{234}\text{U}/^{238}\text{U}$ activity ratios and ^{232}U spike concentration as well as parameters, indicates a good interlaboratory agreement. Sources of total analytical errors can be divided into three types: (1) counting statistic, (2) error caused by the chemical procedure, degree of spectral resolution and peak tail corrections, extent of sample homogeneity and spectral interpretation, and (3) random uncertainty.

Our laboratory is involved in the USIP Phases II and III. The results show that our data are agreeable with the "best estimate" mean values. Dissolution and chemical procedure and source preparation for carbonate samples are examined in detail in order to identify the reasons for variation in chemical yields, thus enabling consistently high yields to be achieved. Methods of the data processing used in measurement of isotopic ratios and calculation, and determination of correcting factors have been carried out. This indicates that a standardization of age calculation procedures for U-series geochronology is required.

The ^{232}Th solution is used as the spike in chemical procedure in order to attempt to determine the age of geological samples. The experimental results suggest that if the sample remained a closed system and U concentration was known, the approach to age-determination would be appropriated.

In addition, two factors of influence, ^{210}Po and $\Delta^{228}\text{Th}$ for determining the ^{232}U concentration in the spike and dating geological samples are discussed here. The maximum influence of residual ^{228}Th ($\Delta^{228}\text{Th}$) on the total counts of ^{232}U can reach 2 percent. It is necessary to make a correction for $\Delta^{228}\text{Th}$. In some cases, where an uraninite is taken as the standard solution to calibrate the concentration of ^{232}U , considerable amounts of ^{210}Po in alpha-spectrum of uranium isotopes would cause unacceptable uncertainties.

9717

CSO: 4009/88

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TITLE: "The Effect of Fluorocarbon Blood Substitute on the Mononuclear Phagocytic System and Antibody Formation"

SOURCE: Tianjin ZHONGHUA XUEYEXUE ZAZHI [CHINESE JOURNAL OF HEMATOLOGY] in Chinese No 3, 30 Jun 84 p 214

TEXT OF ENGLISH ABSTRACT: The effects of perfluorocarbon emulsion (PFE) on the function of the mononuclear phagocytic system (MPS) and humoral immunity were investigated. Four hours after injection of 50 ml/kg PFE into mice, the rate of blood carbon clearance was greatly retarded in comparison with that of the control. Twenty-four hours after the injection, the hepatic uptake of ^{99m}Tc-labeled sheep red blood cells (SRBC) was decreased by 24.83 percent compared with that of the control, while the splenic uptake was increased by 20.73 percent. After Balb/c mice were injected with PFE two days before immunization, the primary IgM response in mouse serum against SRBC was obviously suppressed, with the 10 ml/kg group being 63.09 percent that of the control and the 50 ml/kg group 37.52 percent, but the bone marrow uptake of SRBC was unchanged.

The results indicate that a single intravenous injection of large volume of PFE (50 ml/kg) could temporarily depress the phagocytic activity of the liver and cause partial humoral immunosuppression, but it does not affect the phagocytic activity of the bone marrow. It is suggested that care be taken to preserve the susceptibility to infection, prevention of shock and other abnormalities associated with humoral immunodeficiency during clinical use of PFE.

9717
CSO: 4009/118

Mineralogy

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TITLE: "Phase Equilibria of Altered Mineral Assemblages in Meishan Iron Deposit"

SOURCE: Guiyang KUANGWU XUEBAO [ACTA MINERALOGICA SINICA] in Chinese No 1, 1984 pp 12-20

TEXT OF ENGLISH ABSTRACT: According to the features of altered mineral assemblages, coupled with experimental information and Schreinemaker's method, the authors discuss the physico-chemical conditions of mineralization with respect to the Meishan Iron Deposit. From diorite outwards, labradorite is converted to albite and marialite gradually, and then turns into albite and analcime, indicating an increase in μ_{NaCl} , with the highest value in the marialite zone and then a gradual decrease in μ_{NaCl} . The assemblage salite-Al-bearing andradite is widespread in the deposit. The forming condition of this assemblage is: $T = \text{about } 500^\circ\text{--}600^\circ\text{C}$ and $X_{\text{CO}_2} = 0.2\text{--}0.3$. Tremolite and phlogopite are absent in this deposit, indicating a lower pressure of formation. The occurrence of Al-bearing andradite in both hanging- and foot-walls of the ore body is due to the decrease of pressure of formation and X_{CO_2} . Pyrite and siderite occur on the margin of the ore body, probably as a consequence of the decrease of temperature. In addition, the decrease of temperature has led to an increase in the number of later calcite veins in the deposits. But the presence of either apatite or anhydrite depends mainly on the activity of phosphate or sulfate in ore solutions.

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TITLE: "On the Origin of Violarite from Halatonggou, Xinjiang and Carrollite from Futuyui, Hebei, China"

SOURCE: Guiyang KUANGWU XUEBAO [ACTA MINERALOGICA SINICA] in Chinese No 1, 1984 pp 74-77

TEXT OF ENGLISH ABSTRACT: Taking the copper-nickel sulfide deposit of magmatic segregation origin at Halatonggou, Fuyuan County, Xinjiang, the copper deposit at Futuyui in Leyuan County, Hebei, and siliceous veins containing cobalt-pyrite and cobalt-binarite in the Rehairetian hot water region in Tengchong, Yunnan, as examples, the author discusses the formation conditions and modes of occurrence of violarite and carrollite.

The preliminary conclusions based on the author's work are drawn as follows:

1. The occurrences of minerals of the cobalt-pyrite family are different. Violarite occurs mainly in the copper-nickel sulfide deposits of magmatic segregation origin, while carrollite is produced in the copper deposits of hydrothermal origin. When sulfur occurs as S^- in hydrothermal solutions in hot water regions, cobalt-pyrite and cobalt-binarite other than the cobalt-pyrite family minerals are formed.
2. When the valence of sulfur in ore solutions changes, i.e., the activity of $S^-(\alpha S^-)$ continuously decreases and that of S^{2-} gradually increases until $\alpha S^{2-} < \alpha S^-$, only a few minerals of the cobalt-pyrite family begin crystallizing. When $\alpha S^{2-} >> \alpha S^-$, extensive crystallization of minerals of this family will be expected.
3. In minerogenetic processes, violarite and carrollite may begin crystallizing as long as the oxygen fugacity in ore solutions reduces continuously and the sulfur fugacity rises gradually, indicating that lower fO_2 and higher fS_2 are favorable for the crystallization of the cobalt-pyrite family minerals.
4. Crystallization of the minerals seems to be independent of ore-forming temperature, but their grain-size may have a bearing on the change of ore-forming temperature, i.e., the higher the ore-forming temperature, the larger the grain-size.

9717

CSO: 4009/120

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TITLE: "Composition and Distribution of Malignant Lymphoma in China--
 An Analysis of 3,366 Cases"

SOURCE: Beijing ZHONGHUA ZHONGLIU ZAZHI [CHINESE JOURNAL OF ONCOLOGY]
 in Chinese No 3, 23 May 84 pp 185-188

TEXT OF ENGLISH ABSTRACT: This work is designed to show the composition and geopathologic distribution of malignant lymphomas in China. The sections of 3,366 cases of malignant lymphoma diagnosed from 1978 to 1982 as compiled from 12 different areas in China were reviewed. This series was comprised of 10.9 percent Hodgkin's disease. The non-Hodgkin's lymphomas were further categorized into the B- and T-cell variants. It was impossible to estimate the immunologic type based on the morphologic features in 6 percent of the cases. There were 67.9 percent B-cell lymphomas, of which only 4.4 percent were nodular lymphomas. The T-cell lymphomas ranged from 10.2 percent to 47.6 percent in different areas, averaging 26.1 percent. The T-cell variant was common in certain areas. The findings of the present study may provide useful information for further studies of T-cell lymphomas serologically and immunopathologically and of its relationship with HTLV.

The findings are summarized in the following tables:

Table 1. Histopathological Breakdown of Malignant Lymphomas by Area

	Hodgkin's Disease		Non-Hodgkin's Disease		Total	
	No. of cases	Percent	No. of cases	Percent	No. of cases	Percent
Shenyang	5	10.6	42	89.4	47	100
Nanjing	51	6.9	684	93.1	735	100
Beijing	7	5.9	111	94.1	118	100
Qingdao	24	8.3	265	91.7	289	100
Changsha	51	18.4	226	81.6	277	100
Chengdu	98	18.2	436	81.8	537	100
Lanzhou	7	6.8	96	93.2	103	100
Fuzhou	24	10.0	205	90.0	229	100
Kunming	11	11.2	87	88.8	98	100
Wuhan	44	16.7	220	83.3	264	100
Haikou	11	13.5	152	86.5	163	100
Nanning	34	6.7	472	93.3	506	100
Total	367	10.9	2,999	89.1	3,366	100

Table 2. Breakdown of T- and B-cell Variants of Non-Hodgkin's Malignant Lymphomas by Area

	T-cell Lymphomas		B-cell Lymphomas		T,B Differentiation Difficult		Total	
	No. of cases	Percent	No. of cases	Percent	No. of cases	Percent	No. of cases	Percent
Shenyang	20	47.6	19	45.2	3	7.2	42	100
Nanjing	275	40.2	390	57.0	19	2.8	684	100
Beijing	39	35.1	64	57.7	8	7.2	111	100
Qingdao	79	29.8	174	65.7	12	4.5	265	100
Changsha	61	27.0	157	69.5	8	3.5	226	100
Chengdu	118	26.9	316	72.0	5	1.1	439	100
Lanzhou	23	24.0	64	66.7	9	9.3	96	100
Fuzhou	46	22.4	138	67.3	21	10.3	205	100
Kunming	19	21.8	55	63.2	13	15.0	87	100
Wuhan	33	15.0	182	82.7	5	2.3	220	100
Haikou	22	14.5	112	73.7	18	11.8	152	100
Nanning	48	10.2	364	77.1	60	12.7	472	100
Total	783	26.1	2,035	67.9	181	6.0	2,999	100

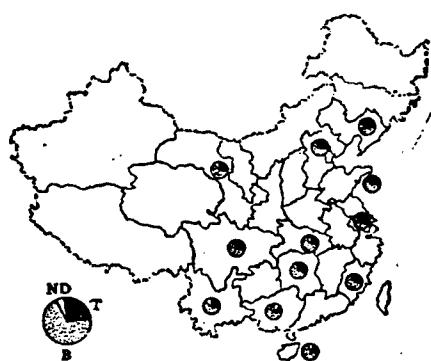
Table 3. Histological Breakdown of T-cell Lymphomas

Histological Type	No. of Cases	Percent
Lymphoblastoid	266	34.0
IBL-T	66	8.4
T-Immunoblastoid	57	7.3
Polymorphocellular	172	22.0
Fungiform Mycosis	14	1.8
T Small Lymphocyte	8	1.0
Unimorphocellular	133	17.0
Leirui's (phonetic) T Lymphoma	9	1.1
Hyalescent Cell Type	46	5.9
Type Difficult to Determine	12	1.5
Total	783	100

Table 4. Histological Breakdown of B-cell Lymphomas

Histological Type	No. of Cases	Percent
Follicular:	90*	4.4
Small Lymphocyte Type	1	0.05
Mitotic Cell Type	49	2.4
Combined Mitotic/Non-Mitotic Cell Type	28	1.4
Non-Mitotic Cell Type	9	0.4
No Record*	3	0.15
Diffused Type:	1,945	95.6
B Small Lymphocyte	91	4.5
Plasma Cell Lymphocyte	94	4.6
Mitotic Cell Type	472	23.2
Combined Mitotic/Non-Mitotic Cell Type	528	26.0
Large Non-Mitotic Cell Type	625	30.7
B Immunoblastoid	66	3.2
Bojite's (phonetic) Lymphoma	41	2.0
Plasmacyte	28	1.4
Total	2,035	100

* There were three instances among the follicular lymphomas in which there was no record of histological type.



Geopathological distribution of 3,366 malignant lymphomas in China.

9717
CSO: 4009/114

Pharmacology

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TITLE: "The Effect of 7α - and 7β -Methyl- 10β , 17β -Diacetoxy- Δ^4 -Estren-3-one
on Terminating Early Pregnancy"

SOURCE: Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese No 3,
29 Mar 84 pp 173-177

TEXT OF ENGLISH ABSTRACT: In the present study, 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one were shown to be able to terminate pregnancy following subcutaneous administration on the seventh and eighth days of pregnancy in rats, and on the fourth and fifth days in mice. The ED₅₀ of 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one for the interruption of early pregnancy in mice was 1.6 mg/kg. Under similar experimental conditions the ED₅₀ of 7β -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one was found to be 5.5 mg/kg. After administration of the effective dose of 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one to early pregnant rats, the peripheral plasma progesterone level was decreased markedly. At the concentration of 10 µg/ml, 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one showed significant inhibiting action on progesterone biosynthesis in the isolated pregnant rat ovary. Relative binding affinity (RBA) of 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one for rabbit uterine estrogen receptor was found to be 10.8 and that of 7β -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one to be 1.5. However, 7α - and 7β -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one were of poor affinity for progesterone binding sites. Results obtained from the uterine growth test in immature mice showed that the estrogen and antiestrogen activity of 7β -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one was weaker than that of 7α -methyl- 10β , 17β -diacetoxy- Δ^4 -estren-3-one.

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TITLE: "Bonded Normal Phase HPLC Determination of Anordrin"

SOURCE: Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese No 3,
29 Mar 84 pp 202-207

TEXT OF ENGLISH ABSTRACT: Anordrin (2α , 17α -diethyl-A-nor- 5α -androstane 2β , 17β -diol dipropionate) is one of the widely used effective oral steroid contraceptives. It consists of two epimers with greatly different biological activity. Variation of quantity ratio between these two epimers often causes uncertainty of action. Therefore, it is necessary to develop a method for determining both epimers accurately.

After careful study of the chromatographic behaviors and configurational relationship between these epimers in various chemically bonded and silica gel supports, a bonded normal phase HPLC determination method is proposed. Epimers can be separated with THF/n-hexane (3~3.5 percent) in cyano- or aminobonded silica gel column and detected by UV detector at 225 nm.

This study also revealed a correlation between the composition of epimer mixture and its melting heat (by DSC). The results showed that measurement of melting heat can be used as a simple but effective method for monitoring the drug quality.

9717
CSO: 4009/93

Radiology

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TITLE: "A Case of Plutonium-239 Contaminated Wound"

SOURCE: Beijing ZHONGHUA FANGSHE YIXUE YU FANGHU ZAZHI [CHINESE JOURNAL OF RADIOLOGICAL MEDICINE AND PROTECTION] in Chinese No 3, 25 Jun 84, p 42-44, 80

TEXT OF ENGLISH ABSTRACT: The treatment of a patient with plutonium-239 contaminated wound is reported. The original activity of plutonium-239 deposited on the wound was estimated to be about 470 μ Ci. The body burden of plutonium-239 was 6.5 Ci on the 140th day, and the total activity of plutonium-239 excreted in urine and feces was 1.3 μ Ci between the 20th and 140th days following the accident. Laboratory findings indicated that the lymphocytes decreased continuously, but serum alkaline phosphatase, alkaline phosphatase of peripheral blood lymphocyte and chromosomal aberrations all increased.

The early surgical wound excision and early DTPA-Ca administration brought about satisfactory results.

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CSO: 4009/119

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